

## **SECTION 16160 PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
  - 1. Distribution panelboards.
  - 2. Transient voltage surge suppressor panelboards.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Section 16450, Grounding.
  - 2. Section 16196, Electrical Identification.

#### **1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

#### **1.4 REFERENCES**

- A. Institute of Electrical and Electronics Engineers (IEEE)
  - 1. IEEE C62.41-1991: Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
- B. InterNational Electrical Testing Association (NETA)
  - 1. NETA ATS-1995: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- C. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA 250-97: Enclosures for Electrical Equipment (1000 Volts Maximum)
  - 2. NEMA AB 1-93: Molded Case Circuit Breakers and Molded Case Switches
  - 3. NEMA ICS 2-93: Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC
  - 4. NEMA KS 1-96: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
  - 5. NEMA PB 1-90: Panelboards

- 6. NEMA PB 1.1-91: General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- D. National Fire Protection Association (NFPA)
  - 1. NFPA 70-99: National Electrical Code
- E. Underwriters Laboratories, Inc.
  - 1. UL 486A-97: Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 2. UL 1449-96: Transient Voltage Surge Suppressors
- F. American National Standards Institute (ANSI)
  - 1. ANSI C12.1 – 1995: Code for Electricity Metering
  - 2. ANSI C12.16 – 1991: Electricity Metering, Solid State Electricity Meters

## 1.5 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Bus configuration, current, and voltage ratings.
    - c. Short-circuit current rating of panelboards and overcurrent protective devices.
    - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports and include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Maintenance Data: For panelboards and components to include in maintenance manuals include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
  - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - C. Comply with NEMA PB 1.
  - D. Comply with NFPA 70.
- 1.7 COORDINATION
- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver equipment as a factory-assembled module with protective crating and covering.
  - B. Lift and support units with manufacturer's designated lifting or supporting points.
- 1.9 SEQUENCING AND SCHEDULING
- A. Coordinate size and location of bracing and supports with wall construction.
  - B. Coordinate size and location of structural-steel support members.
- 1.10 EXTRA MATERIALS
- A. Keys: Six spares of each type of panelboard cabinet lock.

## PART 2 - PRODUCTS

- 2.1 Panelboards are included as part of the directed procurement program for this project. The Construction Manager is administering the program and equipment shall be purchased in accordance with program requirements.
- 2.2 Lighting Panelboards Energy Monitoring is CMFE. See specification Section 16150 for equipment requirements and for actual equipment being provided.

## PART 3 - EXECUTION

### 3.1 SUBMITTALS

- A. Submit shop drawings for approval.
  1. Include overall dimensional drawings showing approximate weight and arrangement.
  2. Indicate on shop drawings, front and side views of panelboards enclosures with dimensions. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, (neutral, if required) and ground; electrical characteristics including voltage, frame size and trip ratings, of all overcurrent devices.

### 3.2 EXAMINATION

- A. Examine rough-in for panelboards to determine proper space and supports are provided.
- B. Examine walls, floors, and areas for suitable conditions where panelboards are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Panels shall be recessed or surface mounted types as required. Where recessed panels are required in functional finished areas, exact location shall be in accordance with elevations provided by the CM. In general, panels shall be mounted 6'-0" from finished floor to top of cabinets, unless otherwise shown.
- C. Panelboards shall be securely and adequately supported by an angle-iron or channel type framework. Surface mounted panelboards shall not be installed directly on a wall. Provide one (1) inch space between back of panel and wall. The Contractor is fully responsible for positioning and locating of every panelboard so, as to provide necessary work access space and clearance to comply with all applicable Codes and Regulations.
- D. Branch circuits shall be arranged and connected to the phases of the panels so that the connected load will be balanced across 3 phases. Circuit numbers on Drawings are for information only and do not intend to be used to be real branch circuit numbers. The contractor shall number all branch circuits in accordance with real circuit breaker layout on a panel. Panelboards directories shall identify each branch circuit. Each branch circuit device shall be numbered or labeled to correspond with the directory, using nomenclature for the final space designations as designated by the CM.
- E. Terminate all raceways and wiring at panelboards. Recessed mounted panelboard shall have three (3) 1-inch empty conduits stubbed into the ceiling space.
- F. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- G. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- H. Install filler plates in unused spaces.
- I. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- J. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.
- K. Coordinate panel locations with architectural features and finishes.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16196, "Electrical Identification."
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws. Name to be inscribed shall be provided by the Construction Manager.

### 3.5 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

### 3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
  - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

### 3.9 PROTECTION

- A. Protect installed panelboards from damage caused by continuing construction.

**END OF SECTION 16160**